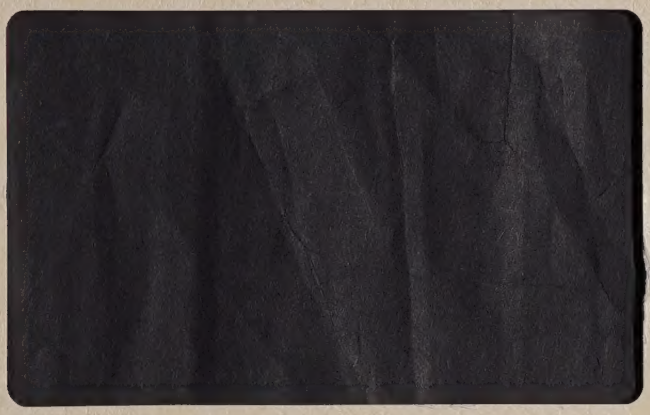
PULSE INSTRUMENTS COMPANY



KABIR, K.
FWAI XEROX

OPERATING MANUAL

Model PI-5800 Data Generator

Model PI-5810 Auxiliary Mainframe

For Tech. Support: BRIAN BRUMFIELD → programmed PI5800 also knows a lot about its hardware. Works in lab at PI.
213-515-5330

PULSE INSTRUMENTS COMPANY

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Torrance, California 90502

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Part Number 91000160

Revision C

Dated July 25, 1984

1.0 WARRANTY AND SAFETY INFORMATION

1.1 WARRANTY

Pulse Instruments warrants this product to be free from defects in material and workmanship for a period of one year from date of shipment.

During the warranty period, Pulse Instruments will, at its own discretion, repair or replace any products or materials returned, freight prepaid, which prove to be defective through normal use.

This warranty does not apply to defects resulting from unauthorized modification, misuse, or neglect. This warranty is in lieu of all other warranties expressed or implied, and Pulse Instruments shall not be liable for any consequential damages resulting from the use of this product.

1.2 SAFETY INFORMATION

1.2.1 General

1. The PI-5800 Data Generator uses a detachable 3-wire power cord for connection to both the power source and to earth ground. This unit is to be connected only to a power source outlet that has provision for properly grounding the plug.

2. Do not operate this unit with covers removed.

3. Service on this product should only be performed by authorized Pulse Instruments personnel. Unless permission to service is granted by Pulse Instruments, any service performed on this Data Generator could void all warranty claims.

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1.2.2 Fuses

The PI-5800 uses quick-acting (normal blowing) fuses designed for general circuit protection. The fuse is located on the bottom right corner of the rear panel. Be certain that input power is disconnected before checking or replacing the fuse.

Power Source	Fuse required
120V.	3AG "Normal-Blo" 8 amp 125V. Littlefuse 312008 or equivalent.
230V.	3AG "Normal-Blo" 4 amp 250V. Littlefuse 312004 or equivalent.

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3.0 SPECIFICATIONS

PI-5800 DATA GENERATOR SPECIFICATIONS

3.1 OUTPUT CHARACTERISTICS

Output Resistance.....Back terminated 50 ohms ± 10%
Pulse Duration.....20ns minimum NRZ mode, 10 ns RZ mode
Fan Out:.....4 TTL loads minimum for duration ≥ 20ns
.....2 TTL loads minimum for duration < 20ns
Skew:.....3ns maximum between any 2 channels on the same 16-channel card
.....4ns maximum between any 2 channel within the same 64-channel unit
Rise and Fall Time:.....tr ≤ 8 ns, tf ≤ 6 ns.
High Level:.....3.5V. minimum, 15ns after rising edge has reached 1.5V
.....3V minimum for duration < 20ns
Low Level:.....0.45V maximum for duration ≥ 20ns
.....0.6V maximum for duration < 20ns
High Impedance.....Disable Time2: tphz ≤ 16ns, tplh ≤ 16ns
.....Enable Time2: tpzh ≤ 23ns, tpzl ≤ 23ns

3.2 INPUT CHARACTERISTICS

External Clock A:.....TTL compatible, 2.4V, 10ns pulse width minimum required
External Clock B:.....TTL compatible, to be driven by cascading clock output only
External Halt:.....TTL compatible, 2.4V, 20ns pulse width minimum required. Positive going or negative going slope selectable by rear panel mounted switch

3.3 TRIGGER OUTPUT CHARACTERISTICS

Trigger:.....TTL compatible. Fan Out = 2TTL load
Programmable Trigger.....TTL compatible. Fan Out = 4TTL loads for duration ≥ 20ns
.....Fan Out = 2TTL loads for duration < 20ns

3.4 GENERAL

Internal Clock Freq.:.....1KHz to 50MHz in 20ns increments.
Instruction Mem. Depth:...999 lines
Display:.....7-inch CRT, 80 characters per line
Memory:.....4,096 bits per channel
CPU:.....Z80A

Compatibility:.....IEEE-488 GPIB, RS-232C
Power PI-5800 .....110 vac ± 10%, 8 amps max. 47/63 Hz
PI-5810.....220 vac ± 10%, 4 amps max. 47/63 Hz
Dimensions:.....10.5" H x 17.5" W x 23.75" D
Weight:.....49-55 lbs. net
Operating Temperature:....0 deg. C to 50 deg. C
Warranty:.....One year parts and labor from date of shipment

Note:

1. Unless otherwise specified, all dynamic measurements are made using a 3 ft. length, 50 ohm coaxial cable transmitted into 15pf/1M ohm (such as the input of a 300MHz oscilloscope).

2. R1=R2=500 ohm, CL=90pf, including 3 ft. of cable capacitance and scope. (See TI TTL Data Book, Volume 3).

4.0 INSTALLATION

4.1 INTRODUCTION

This operating manual contains all the information required to install, operate and program the PI-5800 Data Generator, the PI-5810 Auxiliary Mainframe and all available options and acessories.

The PI-5800 Data Generator is a complex instrument that is capable of performing many tasks. To use this instrument to full advantage, a thorough reading of this manual is required. However, IF YOU WOULD PREFER AT PRESENT TO QUICKLY GAIN ONLY THE BASIC OPERATING KNOWLEDGE TO USE THE INSTRUMENT, PLEASE REFER TO THE SECTION ON QUICK SET UP, Section 9.0.

4.2 PACKING AND UNPACKING

The PI-5800 Data Generator was shipped to you in a foam filled carton that was designed to withstand normal shipping requirements. Please report any damages to the carrier as soon as possible.

The PI-5800 Data Generator was shipped with the following accessories:

1 - Operator's Manual
1 - Mating connector for each 16-channel PC card (the cards are installed in unit)
1 - PC Card Key

Please contact Pulse Instruments immediately if you find any discrepancies.

***** DO NOT TURN THE POWER ON UNTIL YOU HAVE READ THE *****
***** FOLLOWING: *****

4.3 POWER REQUIREMENTS

The Pulse Instruments Model PI-5800 Data Generator is designed to operate from either a 120V or 220V power source, depending upon the model shipped from the factory. The label in the bottom rear corner of the back panel above the power receptacle indicates the voltage input required for operation of your unit. Please verify that the voltage indicated is correct for your intended application before connecting the power cord to the unit or to the power source.

4.4 COOLING AND VENTILATION

To prevent damage or over-heating of your Data Generator, please make certain that there are no obstructions near the unit that would tend to defeat the operation of the rear fans or the air output vents located around the unit. Adequate circulation and ventilation are necessary for proper unit operation and instrument life.

4.5 CONFIGURATION

The PI-5800 is normally supplied in rackmount configuration. If you intend to use the Data Generator for bench top applications only, and you want the decorative 58008 Appearance Kit installed, the factory should be notified of this at the time of ordering, as removal of the rackmount flanges require operations from inside the unit.

All printed circuit boards that are supplied as part of your unit were installed at the factory. This is verified by the configuration display which is visible on the CRT immediately after power up. (To remove this display and get the Master Menu, hit any key--there will be a short delay before the Master Menu is displayed.)

4.6 REAR PANEL CONNECTIONS

Figure 1. PI-5800 Rear View

EXT Clock A .....Allows use of any TTL clock input from D.C. to 50MHz with 10 nanoseconds minimum pulse width.

EXT Clock B.....Used as an input from one of the cascade clock outputs to synchronize PI-5800 to PI-5810 Auxiliary mainframe. This input should not be used as an external clock source, but should be used in conjunction with cascade clock only.

External Halt.....Immediately halts internal clock, can be set to halt on positive or negative pulse by setting its associated switch.

DA.....TTL Clock outputs to be used for synchronization with user's Data Acquisition System.

Cascade Clocks.....Used for supplying synchronized clock outputs to drive PI-5810 Auxiliary Mainframes.

Prog Trig 1.....Allows use of Channel A-1 as a trigger output.

Prog Trig 2.....Allows use of Channel A-2 as a trigger output.

Trig.....Supplies TTL trigger pulse upon occurance of each programmed begin statement.

RS-232C Interface.....EIA standard serial interface.

IEEE-488 Interface.....Interface to general purpose instrument bus.

PI Mainframe Interface..The interface between the PI-5800 Data Generator and the PI-5810 mainframe.

Power Connector.....Accepts supplied 3 wire cord for connection to power source.

J1 - J4.....16-Channel output connectors. See Section 4.7.

J5 - J8.....These connectors are to be used in future configurations and have no purpose at this time. See Section 4.7.

4.7 CONNECTION OF OUTPUT CABLES

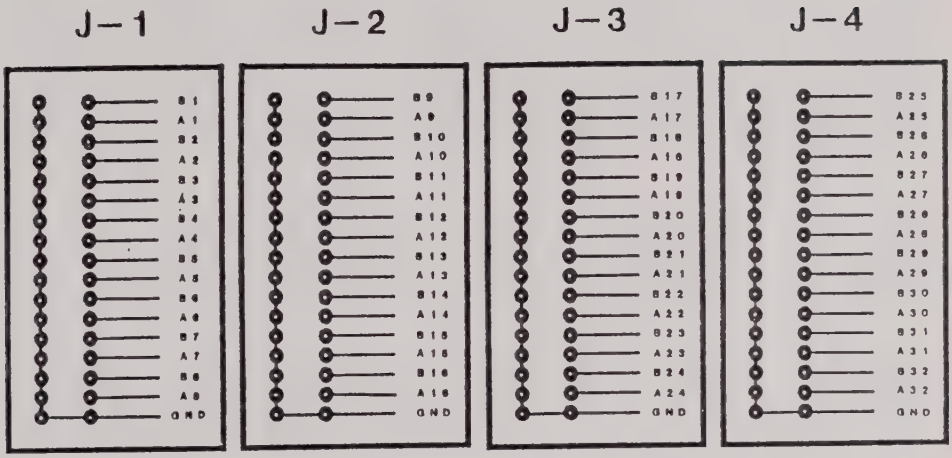


Figure 2. Output Connectors

The 16-channel output cables are connected to J1 through J4 as follows:

J1 Channels A1 through B8
J2 Channels A9 through B16
J3 Channels A17 through B24
J4 Channels A25 through B32

You were supplied with a mating connector for each 16-channel Pattern card supplied. The above drawing provides the output channel pin-outs. It is recommended that all outputs be wired with 50 ohm coaxial cable equivalent to RG 178B/U. Also, cables should not exceed 4 feet in length or serious signal degradation could occur at high frequencies.

If you were supplied with Pulse Instruments cables 88000050 or 88000040, you can connect the cables to the J1 through J4 connectors. The connectors are keyed, and can only be inserted one way. J5 through J8 connectors have no purpose at this time.

5.0 BASIC DESCRIPTION

With true DC to 50 MHz operation, in all modes, and a memory depth of 4K bits for each of 16 to 256 channels, the PI-5800 Data Generator is a versatile digital signal source that can generate extremely long patterns. The instrument is also easy to program.

Most of the programming required for operation of the PI-5800 is accomplished with only 2 menus which cover Pattern and Instruction Entry.

Enhancing the instrument's versatility are the selective output formats, which allow the choice of RZ (return to zero), or NRZ (not return to zero), high impedance or 50 ohm output, and true or complement outputs.

Since patterns can be updated dynamically during run, as much as 99% of a channel's data output can be synchronously changed while the PI-5800 is in the Run mode.

Each channel has a memory depth of 4K bits with 2 levels of looping. As many as 256 repeatable subpatterns may be repeated within the main program to produce patterns exceeding 250 billion bits in length.

The PI-5800 contains two separate sets of random access memory which work in parallel to provide you with pattern generation, while at the same time allowing you to perform other functions, without disturbing the pattern output.

Should you desire to change the pattern output, it can be accomplished easily during the run mode by simply making the pattern changes on the Pattern Entry and Editing Menu, and then pressing the [UPDATE] softkey. The output pattern then contains the changes that were made without stopping the unit to re-program.

Up to four mainframes, each containing four 16-channel data output cards can expand the system to a maximum of 256 channels. Other features of the instrument include output levels of 0 to 3.5V, back-terminated by 50 ohms; an external clock input of DC to 50 MHz; IEEE-488 or RS-232C compatibility; and optional EEPROM program storage. In addition, the instrument accepts optional 16-channel cards, whose delay is programmable in 500 psec increments.

6.0 ORDERING INFORMATION AND OPTIONS

PI-5800 Data Generator.....Mainframe requires printed circuit cards listed below to complete system. Mainframe can accommodate 4 printed circuit cards. For systems requiring more than 64 channels, the PI-5810 Auxiliary Mainframe is required for the additional channels. The PI-5800 is supplied in rackmount configuration, unless otherwise specified.

58001.....16-Channel output printed circuit card, 4K bits memory per channel.

58002.....16-Channel output printed circuit card, with programmable delay from 1 nanosecond to 23 nanoseconds in 500 picosecond increments.

58008.....Appearance Kit. Side covers designed to match top and bottom plates to provide maximum protection for bench top applications, factory installed.

88000040.....IEEE-488 standard cable, 6 feet in length.

88000050.....16-Channel output, 50 ohm coaxial ribbon cable, 4 feet in length, BNC terminated.

88000060.....16-Channel output, 50 ohm coaxial ribbon cable, 4 feet in length, mass terminated both ends.

PI-5810 Auxiliary Mainframe.....Contains power supplies, pattern generation circuitry to support additional 16-channel printed circuit cards. Each auxiliary mainframe can accommodate up to four 16-channel printed circuit output cards.

58101 Non-Volatile Memory Option.....Allows user to store and recall up to 40K bits pattern data and 1000 lines of instrument set-up and pattern data.

58102 Extended Level Looping Option.....Allows further repeat of existing repetition factors to greatly extend pattern looping and nesting capabilities. Also includes conditional branches and GOTO statements, as well as hardware and software flags.

7.0 FRONT PANEL CONTROLS

7.1 GENERAL

***** NOTE: WORDS IN THIS MANUAL WHICH ARE BOTH BRACKETED *****
***** AND UNDERSCORED REPRESENT FRONT PANEL KEYS, EG. THE *****
***** THE RESET KEY IS REPRESENTED BY [RESET]. *****

7.1.1 Power On/Off Switch.....Applies power to the Data Generator; turning power off will remove all contents of the Volatile Memory.

7.1.2 Cursor Controls.....Allows movement of the cursor up, down, left or right. (Cursor movement on each menu is based on individual menu requirements.)

7.1.3 [HOME] Key.....On the Pattern Entry and Editing Menu, pressing the home key once, positions the cursor at bit position one of the cursor's present channel location. The next depression will locate the cursor at bit position one of channel "A1".

7.1.4 [MASTER] Key.....Calls up the directory of all system menus on the CRT.

7.1.5 [ADVANCE] Key.....Increments through the menu sequence to allow selection of the required menu.

7.1.6 Scrolling Controls.....Allows scrolling the CRT screen format up, down, left or right, based on individual menu requirement.

7.2 OPERATIONAL CONTROLS

7.2.1 [R/S] Key.....The [RUN/STOP] key is used to run any program that you want to automatically keep repeating. The unit will continuously run the previously compiled program when the [R/S] key places the unit in the Run mode. The [SINGLE CYCLE] key will run the compiled program one time.

7.2.2 [RESET] Key.....The [RESET] key resets the program in progress for a restart and returns system to master menu display. Volatile memory is not disturbed. See also [CLEAR] softkey in Master Menu, Section 8.2.2.

7.2.3 [SINGLE STEP] Key .....The Single Step mode allows you to step through a pre-selected number of clocks. In order to use this mode, any normal program must be entered and compiled (see Section 8.4.2), and the Data Generator must be in the Stop mode. To run the Single Step mode, first press the [SINGLE STEP] key in the operational controls group of keys. This can be done on any menu display.

The softkeys will now display as follows:

[1 CLOCK] [10 CLOCKS] [100 CLOCKS] [1000 CLOCKS] [EXIT]

By pressing the desired softkeys you can now cycle through any desired number of clocks. Pressing the [EXIT] key will bring back the original softkey displays and exit the Data Generator from the Single Step mode.

7.2.4 [SINGLE CYCLE] .....In the Single Cycle mode, the PREVIOUSLY COMPILED PROGRAM is run, one time through, and the Data Generator stops. You can then re-run the program by pressing the [SINGLE CYCLE] key again. The [R/S] key allows you to run the pattern continuously.

7.3 SOFTKEYS

7.3.1 General

The function and value of the 12 softkeys are software defined. Since each successive menu redefines their use, the softkeys represent approximately 84 different functions. Their location directly below the CRT allows easy coordination with their current value or function, which is displayed on the lower portion of the CRT. Please refer to the menu section for the value and function descriptions of the individual softkeys.

7.4 DATA KEYS

7.4.1 Data Keys

The data keys enable new parameter values and output data to be entered. The PI-5800 will accept hexadecimal or binary entry.

Hexadecimal data is entered with the [0] through [F] keys, and binary data is entered with the [1] and [0] keys. Plese refer to hexadecimal data entry, Section 8.3.5, and Algorithmic Data Entry, Section 8.3.8.

7.4.2 Clear Entry [CE]

The [CE] key will clear out any information that has been entered by the data keys prior to pressing [ENT].

7.4.3 Enter [ENT]

The [ENT] key assembles all new parameter values and performs the entry of these values into program operation.

8.0 SYSTEM MENUS

8.1 CONFIGURATION DISPLAY

Figure 3. Configuration Display

8.1.1 General

Immediately upon Power-up, the PI-5800 Data Generator CRT will show the configuration display. This display shows the six internal card slots and lists their contents. Refering to this menu will let you know how many channels of pattern output are available, which channel cards have programmable delay, or if there are other optional features in the particular unit. Press any key to clear this display and call up the Master Menu.

The PI-5800 runs a set of user established patterns that are set up on the Pattern Entry and Editing Menu. The sequence of these patterns is a set of instructions that are entered on the Instruction Entry and Editing Menu.

8.2 MASTER MENU

Figure 4. Master Menu

8.2.1 General

There are eight menus that can be called in the PI-5800 Data Generator. The Master Menu is the directory of all system menus. Once an operating menu has been selected from the Master Menu display, the [SELECT UP] or [SELECT DOWN] softkeys are used to place the cursor on the desired menu selection. Pressing the [ENT SELECT] softkey will display your selection. As an alternative, the advance key can be pressed to cycle through the menus to get the required display.

The system menus are:

-Pattern Entry and Editing - Section 8.3
-Instruction Entry and Editing - Section 8.4
-Output Format and Channel Status - Section 8.5
-Clock and Interface Set-up - Section 8.6
-Output Waveform Display - Section 8.7
-Self Test - Section 8.8
-High Resolution Channel Delay - Section 8.9

8.2.2 Explanation of the Softkeys

[SELECT UP] - Moves cursor line up to allow menu selection.

[SELECT DOWN] - Moves cursor line in down position to allow menu selection.

[ENT SELECT] - Calls up menu being pointed to by cursor.

[CLEAR] - Resets entire unit, clears all volatile memory and places Master Menu display on CRT. YOU WILL LOSE ALL DATA AND PROGRAMMING LINES!! (Note: when this key is pressed the key will begin to blink. Pressing the key a second time performsthe clear function. Pressing any OTHER key disregards the clear command.)

[SRQ (ON/OFF)] - Enables or disables the Service Request as specified by the IEEE-488.

[GOTO LOCAL] - If the PI-5800 is in the Remote Mode, that is, being operated through the IEEE-488, then this key returns the unit to local operation and renables the keyboard. If IEEE Controller has sent Local Lock Out, then this key is not available.

8.3 PATTERN ENTRY AND EDITING MENU

Figure 5. Pattern Entry and Editing Menu

8.3.1 General

The Pattern Entry and Editing menu provides a display of the individual bit status for the entire system. The display can be scrolled to display all 4,096 bits of memory depth, on each system channel up to the maximum of 256 channels. The 1's and 0's are entered with the data keys at the position of the cursor.

This menu is also used for entering data, establishing the parameters of the subpatterns, setting up mixed format outputs, and many of the PI-5800's editing features.

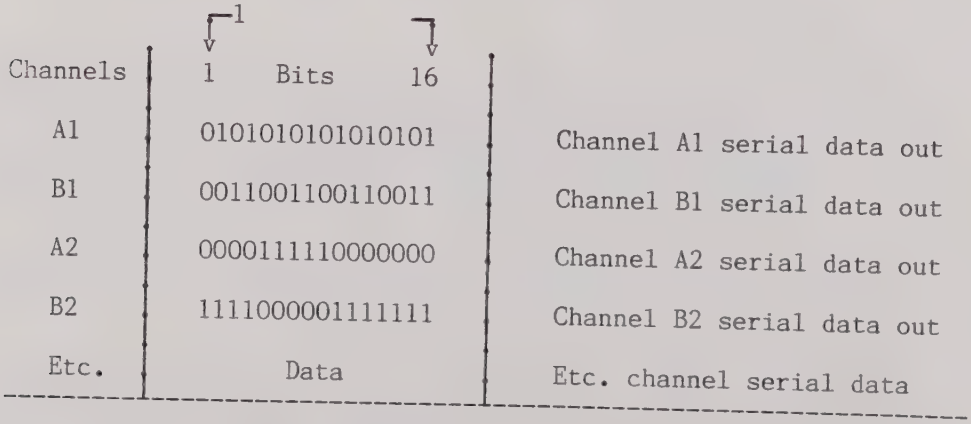
The Pattern Entry and Editing Menu is also used for making asynchronous, "on the fly" data changes and for Dynamic Updating, which will provide a synchronized data change during the Run mode. For example: if the PI-5800 Data Generator is in the Run mode, the following procedure will allow you to make an "on the fly" output data change. Place the cursor on the bit that you wish to change and depress either [1] or [0] to place the desired data bit into the pattern. Once the desired data changes have been completed, press the [UPDATE] softkey and the data change is made in the output.

The Pattern Entry and Editing Menu is also used for providing bit format status within the pattern. For example, an NRZ output is displayed in normal video, an RZ output is shown in reverse video, and a High-Impedance output is shown as dashes in the bit locations instead of the normal 1's and 0's. This provides an easy to read status of the output formats that the system is currently providing.

8.3.2 Subpatterns

A subpattern is a memory field that is defined on the Pattern Entry and Editing Menu, which holds data for use as an output pattern. The subpattern is established between bit positions on the Pattern Entry and Editing display. These bit positions will represent serial strings of data. The patterns can be any length from a minimum of 12 bits to a maximum of the 4,096 bits, or the total channel memory. When the subpattern is established it extends throughout all the channels in the system and is independent of data. The subpattern is like a mail box into which output data will be added later. Figure 6 shows how the subpattern is defined and how it extends through the channels.

Figure 6. Defined Subpattern



If you do not understand the concept of subpatterns at this point, it is advisable to:

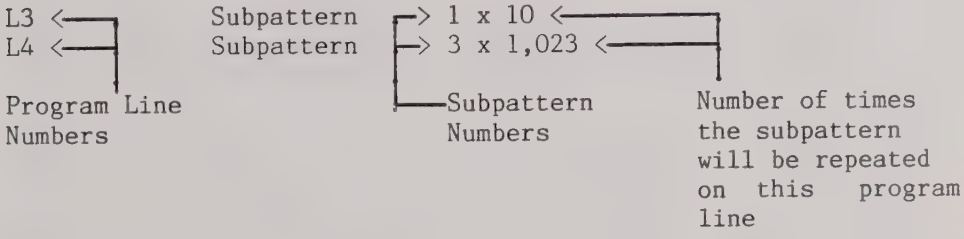
1. View the Pattern Entry and Editing Menu on the PI-5800.

2. Read Section 8.3.3, Setting Up Subpatterns and the explanation of Pattern Entry and Editing Menu softkeys [START SP] and [END SP], Section 8.3.6.

3. Read or perform, Quick Set-Up, Section 9.0.

There can be a maximum of 255 subpatterns established within the 4,096 bits of channel data available. When added as a program statement on the Instruction Entry and Editing Menu, the subpattern can be repeated up to 1,023 times. See [SUBPATTERN] softkey, Section 8.4.2, Instruction Programming, Section 8.4.3.

The followng are examples of program lines showing use of the subpattern statement as displayed on the Instruction Entry and Editing Menu:



8.3.3 Setting Up Subpatterns

Here is a sequence of events that demonstrate how to build a subpattern.

1. Press [MASTER] key, then press [CLEAR] softkey twice.
2. Press the [ADVANCE] key to call up the Pattern Entry and Editing Menu.
3. In the cursor/menu group of keys, press the [HOME] key two times. Verify that the cursor is located on Bit 1, Channel A1.
4. Press the [START SP] softkey. You should now see a curved arrow and 1 above bit position 1.
5. Using the [CURSOR RIGHT] control, place the cursor at bit position 16.
6. Press the [END SP] softkey. You should now see a curved arrow above bit position 16. (The two arrows define subpattern 1 which now exists between bit position 1 and 16 throughout all the channels in the system.) Refer to Figure 6.

8.3.4 Loading Data into Subpatterns

There are many ways to load data into the established subpatterns.

1. Download from you host computer.
2. Download from the IEEE-488 bus. (See Programming Section 11.0.)
3. Binary data key entry. (See below.)
4. Hexadecimal data entry. (See Hexadecimal Data Entry, Section 8.3.5.)
5. Algorithmic data entry. (See Algorithmic Data Entry, Section 8.3.8.)

Here is a sequence of events that demonstrates loading data by binary data key entry. IF YOU HAVE NOT SET UP A SUBPATTERN, PLEASE REFER TO SECTION 8.3.3 ON SETTING UP SUBPATTERNS BEFORE CONTINUING.

1. Press the [HOME] key two times. Verify that the cursor is located on bit 1, channel A1.

2. Using the data keys, alternately press data keys [1] and [0] to load data into the subpattern. NOTE: any data entered out of a subpattern structure will not be part of the output pattern.

3. Press the [CURSOR DOWN] key to place the cursor in channel B1.

4. Press the [HOME] key one time. You should now be at bit position one, channel B1. Load the data using data keys [1] and [0].

5. Press [UPDATE] softkey.

6. You are now ready to establish the program to output the pattern you have built. Refer to the Instruction Entry and Editing Menu to set up the program (See Section 8.4).

8.3.5 Hexadecimal Data Entry

Hexadecimal data entry is useful for specific applications and to speed parallel data entry. In binary data entry, the pattern output data is entered serially within a specific channel in 1's and 0's. In hex data entry, the data is entered in hexadecimal notation "down the channels." For example, a hex entry at bit position one of FFF hex would place the data parallel through 12 channels at bit position one. Each hex character used extends the parallel data down the channels by its 4 bit count. FF hex places data 8 channels down, C4C hex places data down 12 channels and CCDE hex would extend the data down 16 channels. The data is entered down the channels from the location of the cursor.

8.3.6 Explanation of Softkeys

8.3.6.1 Page 1 Softkeys

[START SP] - Defines the start of a subpattern by placing an arrow above the cursor/bit position of the subpattern starting point. Each subpattern established is automatically numbered sequentially at the position established, and extends through all output channels in the system. Minimum subpattern length is 12 bits. The maximum subpattern length is 4,096 bits, or one subpattern which occupies all the data available in the channel.

[END SP] - Defines the end of a subpattern by placing an arrow above a cursor/bit position. This defines the end of the subpattern at this position for all output channels in the system.

[GOTO] - Allows instant access to locations in pattern memory at any bit, channel or subpattern location. Statement examples are as follows:

[GOTO] [START SP] [1] [ENT] - Places cursor at first bit or start of selected subpattern, in this case subpattern 1.

[GOTO] [END SP] [2] [ENT] - Places cursor at last bit or end of selected subpattern, in this case the end of subpattern 2.

[GOTO] [START SP] [2] [+] [2] [ENT] - Places cursor at location of third bit in subpattern 2. Note that the statement, [GOTO] [START SP] [2] [ENT] would place the cursor on the first bit in subpattern 2, so the statement [GOTO] [START SP] [2] [+] [2] [ENT] would place the cursor 2 bits beyond the start of subpattern 2, or at bit position 3 in subpattern 2.

[GOTO] [END SP] [3] [-] [2] [ENT] - Places the cursor at location of third bit from end of subpattern 3. Note that the statement, [GOTO] [END SP] [3] [ENT] would place the cursor on the last bit in subpattern 3, so the statement [GOTO] [END SP] [3] [-] [2] [ENT] would place the cursor 3 bits before the end of subpattern 3.

[GOTO] [CHANNEL] [A] [6] [ENT] - Will place the selected channel in the Pattern Entry and Editing Menu display, (the cursor will be in the selected channel at the same bit position it occupied before the command).

[GOTO] [X] [X] [X] [ENT] - Places the cursor at the selected bit location within the 4,096 bit memory. Cursor will be on the same channel as before entry of the statement, but at the new bit location.

[CHANNEL] - Used in conjunction with [GOTO] softkey to instantaneously call up any desired output channel and place it in the Pattern Entry and Editing Menu display. Refer to [GOTO] softkey for example of use.

[RZ] - Softkey used for setting the RZ mode in mixed format outputs. The softkey cycles through [RZ], [RZ (ON)], and [RZ (OFF)].

[RZ (ON)] - Sets output format to RZ in mixed format modes at bit position of cursor.

Note: Pressing the [RZ] softkey will cycle the softkey to display [RZ (ON)]. The warning: DATA IN B CHANNEL WILL BE LOST -- PRESS [ENT] -- TO CONFIRM, will be displayed. (In multiple format mode, the B channel is used for control). Once [ENT] is pressed, the B channel is lost and RZ data can be entered by pressing the [1] and [0] data keys or the [CURSOR LEFT] and [CURSOR RIGHT] keys. See Section 8.5.3 for description of output format modes.

[RZ (OFF)] - Allows removal of RZ data from display, when cursor is advanced through the previously defined RZ data (this area is marked by reverse video). When all the RZ data is removed, the channel will return to its normal state and the B channel will, once again, be available for use. To take the channel out of mixed format mode without removing all the RZ data in that channel, go to the Output Format and Channel Status Menu and place the cursor on the channel you want to change and press the [RZ/NRZ OFF] softkey. This will place the channel in the non-mixed NRZ mode. See Section 8.6.4 for description of output format modes.

[HI-Z] - Places any "A" channel in High Impedance mode. The "A" channel to be placed in High Impedance is determined by the location of the cursor. Note: Pressing the [HI-Z] softkey will display the following warning with reference to the B channel paired with the "A" channel which will enter High Impedance mode: DATA IN B CHANNEL WILL BE LOST -- PRESS [ENT] -- TO CONFIRM. (HI-Z is removed from the output of the channel pair by removing all the dash High Impedance video indicators from the A channel and replacing them with 1's and 0's.) This automatically places the output format in the channel pair to RZ or NRZ depending upon the program in progress. To take the channel out of the High Impedance mode without removing all the dashes present in that channel, go to the Output Format and Channel Status Menu and place the cursor on the channel you want to change and press the [HI-Z OFF] softkey. This will return the channel to its normal state and allow access to the B channel. See Section 8.5.3 for description of output format modes.

[DF DYN UPD] - Defines a block of eight channels to be updated. The number of channel blocks can be any number from one block of eight to the entire system.

[EX DYN UPD] - Executes the synchronous update and pattern change of the channel blocks defined by the [DF DYN UPD] softkeys.

[UPDATE] - Enters any data change displayed on the CRT into the output pattern when pressed. This is an asynchronous "on the fly" change. For example: If an output pattern is established, changing the data as displayed on the CRT will not create a change in the output data until the [UPDATE] softkey is pressed, at which point the new data will replace the existing data at the changed bit positions in the output pattern.

[MORE...] - Calls up and displays second page of softkeys used with the Pattern Entry and Editing Menu. Pressing [MORE...] again will call up and display first page of softkeys.

8.3.6.2 Page 2 Softkeys

[START SP] - Same as [START SP] on Page 1 of softkeys. Included on Page 2 of sofkeys for editing convenience.

[END SP] - Same as [END SP] on Page 1 of sofkeys . Included on Page 2 of sofkeys for editing convenience.

[GOTO] - Same as [GOTO] on Page 1 of sofkeys . Included on Page 2 of sofkeys for editing convenience.

[DELETE SP] - The statement [DELETE SP] [X] [ENT] will remove the subpattern X from the Pattern Entry and Editing Menu.

[MOVE] - Moves the start or end of a subpattern to the cursor position to either increase or decrease the bit length of the subpattern. For example: [MOVE] [START SP] [X] [ENT], would place the start of subpattern X at the present cursor position.

[A+B (ON/OFF)] - The [A+B (ON/OFF)] softkey cascades the A channels. See Cascade Mode, Section 8.3.9.

[UPDATE] - Same as [UPDATE] on Page 1 of sofkeys on Pattern Entry and Editing Menu. Included on Page 2 softkeys for editing convenience.

8.3.7 Editing

This menu also provides a second page of pattern editing softkeys for manipulation of data patterns during set-up. Press the [MORE...] softkey to get second page editing softkeys. The functions available are, delete subpattern, move subpattern, cascade "A" and "B", insert bit, delete bit, and "GOTO" statements. The "GOTO" statements allow call-up of any subpattern location, or any bit location within the channels. Refer to Section 8.3.6 for explanation of this softkey function.

8.3.8 Algorithmic Data Entry

Algorithmic Data Entry allows the entry of repetitious data patterns in a selected channel by an easier method. For example: the following pattern, 1010101010101...1010, where the number of bits is 50 can be entered with the data entry keys in the following manner: [(] [1] [0] [)] [X] [2] [5] [ENT]. You will note that the statement is assembled in the lower left corner of the CRT, directly above the softkeys. The data stream which is 50 bits in length will be inserted in the desired channel at the bit position of the cursor. This method can be used for creating patterns of any length as long as the total number of bits does not exceed 4,096 in any channel.

8.3.9 Cascade Mode

The Cascade Mode allows you to set a single subpattern which will provide up to 8,192 bits of serial data from the "A" channel outputs. In this mode, the "A" and "B" channels are "tied" together and the "A" channel will "toggle" between its 4,096 bits maximum and the 4,096 bits maximum that are established in its paired "B" channel. The Cascade Mode affects all the channels in the system.

To accomplish the Cascade Mode and to allow a synchronous transfer of data, the first bit in the subpattern of both the "A" and "B" channels must be the same, and the last bit in the subpattern of the "A" and "B" channel must be the same. The first bits can be 1 or 0, and the last bits can be 1 or 0. You should have only one subpattern established which can be up to the full channel memory depth. When the Cascade Mode is established, it is in effect for all A-B channel pairs in the entire system, so you are effectively reducing your number of channels available by one-half, but increasing your "A" channel memory by a factor of 2. Only one subpattern pattern can be etablished in this mode. Pressing the [A+B (ON/OFF)] softkey places the unit immediately into the Cascade Mode.

Note: This is an asynchronous change, so you should be in the stop mode.

8.3.10 Dynamic Update (synchronous)

Dynamic Update replaces the entire contents of an "A" channel with the contents of its paired "B" channel, synchronously. This process can be established for any group of 8 channels, and from a minimum of 8 channels to a maximum of the entire system. The [DF DYN UPD] softkey is used to establish the channel groupings that will be updated by this process. The [EX DYN UPD] softkey performs the actual update. NOTE: DYNAMIC UPDATE OVERWRITES ALL A CHANNEL DATA AT TIME OF UPDATE, AND IT WILL BE LOST.

8.3.11 Update (asynchronous)

Since the PI-5800 has a separate set of RAM for the CRT display, it is possible to make pattern changes in the data displayed on the Pattern Entry and Editing Menu without affecting the output. These pattern changes can be added to the output asynchronously by pressing the [UPDATE] softkey. For example: Place the cursor at a bit position you want to change. Change the bit with the [1] and [0] data keys. Press the [UPDATE] softkey.

8.4 INSTRUCTION ENTRY AND EDITING MENU

Figure 7. Instruction Entry and Editing Menu

8.4.1 General

The Instruction Entry and Editing Menu is used for establishing the sequence of subpatterns that will be required for a specific pattern application or program.

The menu allows operation of the Data Generator in very a simple form; insert one pattern and run continuously, or in more complex form, where as many as 256 different subpatterns can be intermixed as required. Two levels of looping let you create highly complex patterns in a simple manner that requires only 2 statements. This menu is also used for storage of different pattern group programs that can be selected and run as required.

With the optional EEPROM non-volatile memory, you can save the instruction lines of this menu.

***** NOTE: WHEN USING MORE THAN ONE SUBPROGRAM, IT IS *****
***** NECESSARY TO LEAVE AT LEAST TWO (2) BLANK LINES IN *****
***** BETWEEN EACH SUBPROGRAM. *****

8.4.2 Explanation of Softkeys

[BEGIN] - Assigns a number in sequence to allow differentiation between programs. Begin can be a number from 1 to 256. The first use of the begin statement will be Begin 1, and each successive number in series is assigned automatically. Deleting a Begin statement number removes it from use until the Data Generator is reset by pressing the [CLEAR] softkey on the Master Menu or turning off power. It is advisable to always call up any programs that are stored in EEPROM memory if you have this option, since upon reset, pressing the [BEGIN] softkey will start over at Begin 1. You can use the Begin 1 program that you have created. However, if you enter it into EEPROM memory, it will replace the Begin 1 program in memory if that number has been previously used. Therefore, it is better to always call up any programs in EEPROM memory to verify the Begin numbers that are used, in the event you decide to save the program you are building. [BEGIN] starts a program and [COMPILE] completes it.

[SUBPATTERN] - Is used as part of the program listing to allow you to select the subpattern you wish to run, and to identify the intermixed subpattern sequence. Pressing the [SUBPATTERN] softkey sets a subpattern in the program sequence at the line location defined by the cursor. The subpattern number and repetition rate are then established on the same line. The maximum subpattern number is 255 (the maximum number of subpatterns that can be established) and the maximum repetition factor on a given instruction line is 1,023.

[REPEAT] - Allows any group of subpatterns within a user specified line sequence to be repeated in a single statement up to 255 times. Example: Repeat from line 2 to line 3 X 7. The statement means: Repeat line 2, then 3, 7 times.

[REP FACTOR] - Pressing the [REP FACTOR] softkey sets the number of times a subpattern or repeat statement is to be repeated on a program line. This softkey is pressed to change repetition factors in established programs at the line position of the cursor.

[GOTO LINE] - Placed the cursor on any selected program line from 1 - 999. For example: [GOTO LINE] [X] [X] [X] [ENT] will place the cursor on line X X X.

[INSERT] - Moves all programming lines down one line from the cursor line position. Used for insertion of additional subpatterns or repeat statements.

[DELETE] - Removes the line at the cursor line position and moves all other program lines up one line.

[COMPILE] - Translates the program that the user has written into code that the PI-5800 can understand. [BEGIN] starts a program and [COMPILE] completes it. The [COMPILE] softkey is also used to change output programs. If you are running program Begin 2, the following statement will change the output: [COMPILE] [1] [ENT]. This will change the output to the Begin 1 program. When you press the [COMPILE] softkey, a prompt is displayed on the CRT that states: Enter Begin No. [ENT]. When you enter the begin number and press the [ENT] key, the unit begins to compile the program. If the unit was in run mode at this time, both the pattern output and the clock will stop, then the compile will be performed. Once compile is completed, the unit will begin to run again. If the unit was in the stop mode at the time you pressed compile, it will still remain in stop mode after the compile is completed. The unit will then run the program specified by the begin number entered, when the [R/S] key is pressed. If you enter a begin number for a program that has not been defined (unit has incremented begin 1 and begin 2 and you enter 3), the CRT will display the error, "Invalid BGN NO".

8.4.3 Instruction Programming

There are only 4 statements required for programming the PI-5800.

To start a program, the [BEGIN] softkey is pressed. This action will display the word Begin and the next available number in sequence. If you have begun programming from a [CLEAR] (Master Menu system reset), the first assigned number would be Begin 1. The next step will be to enter the subpatterns that you would like to run in the sequence required. Subpatterns can be intermixed in sequence and repeated as required.

Here is a sample program to show how it is done:

ACTION TAKEN	PROGRAM LINE NUMBER	PROGRAM RESULT
Press [BEGIN]	L1	Begin 1
Press [SUBPATTERN] Press [1] and [ENT] Press [1] and [ENT] (You have now completed program lines L1 and L2	L2	Subpattern 1 x 1
Press [SUBPATTERN] Press [2] and [ENT] Press [5] and [ENT] (You have now completed program line L3)	L3	Subpattern 2 x 5
Press [REPEAT] Press [2] and [ENT] Press [4] and [ENT] (You have not completed program line L4)	L4	Repeat line 2 to line 3 X 4
Press [COMPILE] Press [1] and [ENT] Program is complete.		The flashing indicator will tell you to enter begin number.

The basic program shown above would be (SP 1 X 1 + SP 2 X 5) X 4.

The Data Generator will now run subpattern 1, one time, then run subpattern 2, five times, repeating that sequence four times. The instrument will then start over again.

Note:

You can intermix subpatterns and use them as required on this menu. However, each repeat statement must stand alone and cannot share any program lines with any other repeat statement, since this would represent a third level of looping.

8.5 OUTPUT FORMAT AND CHANNEL STATUS MENU

Figure 8. Output Format and Channel Status Menu

8.5.1 General

This menu displays the output format and channel status. Each channel can be set to be either a complement of the existing data output, non-complement, RZ (return to zero), or NRZ (not return to zero). ALL FUNCTIONS ON THIS MENU ARE BLOCK CHANGES THAT WILL AFFECT THE ENTIRE CHANNEL (See mixed output formatting, Section 8.5.4).

8.5.2 Explanation of Softkeys

[NON-INVERT] - If the output of a given channel is inverted, pressing will change the output to not inverted or normal. The softkey acts upon the channel at the cursor position.

[INVERT]- Inverts the output of the channel at the cursor position.

[NRZ] - Changes the ENTIRE output of the channel at the cursor position in RZ format to NRZ format.

[RZ] - Changes the ENTIRE channel output of the channel at the cursor position in NRZ format to RZ format.

[HI-Z OFF] - Returns the channel at the cursor position to normal.

[RZ/NRZ OFF] - Returns the channel at the cursor position to normal.

8.5.3 Output Formats

RZ - Output follows data, returning to zero during any data 1 output.

NRZ - Output stays high on data 1's until clock leading edge of 0 data output.

RZ/NRZ - This is a mixed-mode format where RZ and NRZ data is present at the same time in the same channel.

HI-Z - High Impedance Output, "floats" between low and high.

TRUE - Normal data output. (Non-Invert)

COMPLEMENT - Inverse of normal data output. (Invert)

With the PI-5800, you can run (RZ) Return to Zero, (NRZ) Not Return to Zero, RZ/NRZ (a mixed mode of RZ and NRZ on the same output), (HI-Z) High Impedance, true and complement output formats. When running an entire channel in RZ, True, Complement, or NRZ format, the "A" and "B" channels are identical in function and any of the format outputs listed in this paragraph can be run on any channel as long as you are running the format throughout the entire channel.

It is also possible to mix formats on the "A" channels. The PI-5800 is designed to give you this capability by using the "B" channels as the control channels to allow these special applications, hence the channels are set up in "A" and "B" fashion with each complimentary pair sharing the same integer A1 - B1, A2 - B2...

8.5.4 Mixed-Mode Channel Formatting

The PI-5800 allows you to mix channel formats. When mixing 2 formats on an "A" channel, i.e... RZ - NRZ, or RZ - HI-Z, the B channel is sacrificed and becomes a control channel. This mode of operation is established by using the Pattern Entry and Editing Menu. You can use any two of the three formats at a time on any "A" channel, but not all three. However, you could run RZ-NRZ on channel "A1" and RZ - HI-Z on channel "A2" or any combination of 2 on any "A" channel desired. In the mixed format mode, you also have the invert (complement) and non-invert (true) formats available on all "A" channels. Mixed formatting is established with the use of the Pattern Entry and Editing Menu, Section 8.3.

8.6 CLOCK AND INTERFACE SET-UP MENU

Figure 9. Clock and Interface Set-Up Menu

8.6.1 General

This menu allows selection of clock parameters, the IEEE-488 GPIB instrument address, and the RS-232C information. The clock portion of the menu displays selected internal or external clock, and the internal clock period, in 20 nanoseond increments, from 20 nanoseconds to 1.3107 milliseconds, which will provide clock frequencies from 762.95 Hz to 50 MHz. The external clock input allows the use of any TTL clock in the range from DC to 50 MHz with a 10 nanosecond minimum pulse duration. The PI-5800 clock is programmed to operate at 50 MHz upon start-up, or upon system reset, by pressing clear on the Master Menu.

The IEEE-488 GPIB instrument address is set by the coded setting of the DIP switch on the rear panel of the Data Generator. This setting can be from 0 to 31. The selected address number is then displayed on the IEEE-488 interface section of this menu.

The RS-232C section of the menu provides information on the current setting of the Unit Baud Rate. The Baud Rate is adjustable from 50 to 19,200 Baud. You can also select the number of stop bits, and parity.

8.6.2 Explanation of Softkeys

[BAUD RATE UP] - Sequences in ascending order through all available baud rates from 50 to 19,200.

[BAUD RATE DOWN] - Sequences in descending order through all available baud rates from 19,200 to 50.

[STOP BITS] - Allows selection of either 1 or 2 Stop Bits.

[MILLISEC] - For period settings in milliseconds.

[MICROSEC] - For period settings in the microseconds.

[NANOSEC] - For period settings in the nanoseconds.

[HALT (ON/OFF)] - The Halt Mode allows the PI-5800 to be stopped externally by a positive or negative going pulse. With the unit in the Run Mode and the Halt ON, the PI-5800 will stop if an appropriate signal is fed into the External Halt input on the rear panel (See Section 4.6). Note: when the halt is received, the unit will stop running and the Halt Mode will be turned OFF.

8.6.3 Setting the Internal Clock Period

The internal clock period is set using the Clock and Interface Set-Up Menu, by using the data keys to set the decimal number and the softkeys to establish the time. The PI-5800 will only establish the internal clock periods in 20 nanosecond increments, so any decimal entry will be rounded off to the nearest 20 nanosecond increment. (If the number 5 is rounded off by the PI-5800, the result will be higher.) For example: an entry of [PERIOD] [3] [5] [NANOSEC] [ENT] would round off to 40 nanoseconds, which would then be displayed as the internal clock period. The clock period set-up would be as follows:

[PERIOD] [8] [2] [NANOSEC] [ENT]- Pressing the [ENT] key will automatically enter the new internal clock period and round it off to the nearest 20 nanosecond increment. The display will now read 80 nanosecond internal clock period. The internal clock period can be set from 1.3107 milliseconds to 20 nanoseconds in 20 nanosecond increments, so your clock frequency steps would be 50 MHz, 25 MHz, 12.5 MHz, etc. If an attempt is made to set a clock period that is less than 20 nanoseconds, the clock period will automaticaly default to 20 nanoseconds. If an attempt is made to set a clock period of more than 1.3107 milliseconds, the CRT will display the error message "Period Too Long." All clock

period entries must be made in whole number or whole number/decimal form, i.e. [PERIOD] [1] [MILLISEC] [ENT], [PERIOD] [0] [.] [2] [5] [MILLISEC[[ENT]. Entering [PERIOD] [.] [2] [5] [MILLISEC] [ENT] will display a syntax error. Pressing the [CLEAR ENTRY] key will clear any error messages or any errors in data entry. See Section 11.3, Programming Commands.

8.6.4 External Clock Input

The PI-5800 can be driven by an external TTL clock input in the range from DC to 50 MHz. The external clock input is not limited to 20 nanosecond increments, so the clock input can be any desired frequency as long as the mimimum pulse width is 10 nanoseconds. If you use the external clock input, make certain that the rear panel EXT CLK A switch is in the ON position.

8.8 SELF TEST MENU

Figure 11. Self Test Menu

8.8.1 General Description

The self test feature provides a quick functional test of a large portion of the circuitry inside the PI-5800. Four softkeys allow selection of tests that verify operating integrity at various critical locations. The bank numbers refer to specific memory locations and the display indicates either a Pass (P), Fail (F), or Don't Care (X) condition exists.

8.8.2 Explanation of Softkeys

[MEM TEST] - Tests most of the unit's memory locations. This is a non-destructive test (no loss of RAM information).

[DMEM TEST] - Conducts a more thorough test of memory which includes all address points. This is a destructive test (loss of information in RAM).

[CNTR TEST] - Tests all counters on the address generater card.

[FNCTN TEST] - Runs a pre-programmed pattern to verify operation.

8.9 HIGH RESOLUTION CHANNEL DELAY MENU

Figure 12. High Resolution Channel Delay Menu

8.9.1 General Description

The High Resolution Channel Delay Menu provides a status board to facilitate adjustment of the output skew between channels in units that are equipped with the Pulse Instruments Part Number 58002 - 16-channel output cards with programmable delay. The output delay in each channel is adjustable over a range of 23 nanoseconds. The adjustments allow incrementing ([INC DLY .5]) or decrementing ([DEC DLY .5]) the delay in 500 picosecond increments on the channel at the cursor position.

9.0 QUICK SET-UP AND USE

This section is designed to give you the basics of operation of the PI-5800 in a condensed manner, by setting up the unit and running a pattern.

Equipment Required

1 BNC cable approximately 4 feet in length

150 MHz Oscilloscope

16-Channel output cable (P/N 88000050) for connection from the Output Connector J-1 to oscilloscope.

PI-5800 Data Generator

1. Plug the 16-channel output cable into connector J-1. Refer to Section 4.7 for J-1 pin out configuration. (If you do not have the P/N 88000050 output cable, you will require 2 BNC terminated 50 ohm coaxial cables which will be connected to channels "A1" and "B1".)

2. Connect channels "A1" and "B1" to the oscilloscope.

3. Verify that EXT CLK A switch on rear panel is in OFF position.

4. Connect BNC cable from TRIG on rear panel to EXT trigger input on oscilloscope.

5. Verify that front panel power switch is in the OFF position.

6. Plug AC power cord into rear panel power receptacle, and connect to power source.

7. Turn on unit power. After a few seconds, you will see the Unit Configuration display. This menu provides information on what PC boards and feature are contained within your particular unit. (Press any key and the Master Menu will be displayed.)

8. Press the [ADVANCE] key to call up the Pattern Entry and Editing Menu.

9. In the Cursor/Menu group of keys, press the [HOME] key 2 times. Verify that the cursor is located on Bit 1, Channel A1.

10. Press the [START SP] softkey. You should see a curved arrow and 1 above bit position 1.

11. Using the [CURSOR RIGHT] key, place the cursor at bit position 16.

12. Press the [END SP] softkey. You should see a curved arrow above bit position 16.

13. Press the [HOME] key once to place the cursor back at bit position 1.

14. Using the Data Entry keys, alternately press data keys [1] and [0] to load data in Channel A1 between the subpattern arrow indicators out to bit position 16.

15. Press the [CURSOR DOWN] key to place the cursor in channel B1.

16. Press the [HOME] key one time. You should now be able to load data in channel B1 between bit position 1 and bit position 16.

17. Press the [ADVANCE] key one time to display the Instruction Entry and Editing Menu.

18. Verify that the cursor is at position L1. If not, press the [HOME] key or move the cursor to line L1.

19. Press the [BEGIN] softkey. The display now reads Begin 1 on line L1.

20. Press the [SUBPATTERN] softkey. Subpattern is now displayed on line L2.

21. Press the [1] data key and [ENT]. The subpattern is now defined as subpattern 1.

22. Press the [1] data key and [ENT]. You have now set the repetition factor at 1.

23. Press the [COMPILE] softkey.

24. Press the [1] data key and [ENT]. You have now instructed the Data Generator to translate the Begin 1 program.

25. Press [MASTER] key to call up the Master Menu.

26. Press the [ADVANCE] key one time to call up the Pattern Entry and Editing Menu.

27. Press the [UPDATE] softkey. This function will set the data into the pattern generator.

28. Press the [RUN/STOP] key. The Data Generator should now be in Run mode and the pattern entered in Step 14 should be displayed on the oscilloscope, when triggered properly.

10.0 THE PI-5810 AUXILIARY MAINFRAME

10.1 GENERAL

The PI-5810 is an auxiliary mainframe which is attached to the PI-5800 Data Generator to extend channel output capability. Each PI-5810 connected to the PI-5800 can be configured with up to 4 16-channel output printed circuit cards. Three PI-5810 Auxiliary Mainframes can be connected to each PI-5800 to extend system channel output capacity to a maximum of 256 channels.

All of the functions of the PI-5810 are controlled directly by the PI-5800 once connection is made. The information given here is for connection of one PI-5810, however, connecting the maximum 3 units would be identical to connecting the PI-5800 Data Generator to a single PI-5810 Auxiliary Mainframe.

Cables Required

1. PI Mainframe Interface Cable - supplied by Pulse Instruments.

2. BNC terminated 50 ohm coaxial cables, user supplied. These cables are used for clock synchronization between the PI-5800 and the PI-5810. Their length should be identical and should not exceed 4 feet. The ideal length for these cables is approximately 2 feet.

10.2 PI-5800 TO THE PI-5810 CONNECTIONS

Cables required - 1 PI mainframe interface cable
2 BNC cables

1. Connect the PI-Mainframe Interface Cable supplied with the PI-5810 between the PI-5800 Data Generator and the PI-5810 Auxiliary Mainframe.

2. Verify that the EXT CLK A switch is OFF.

3. Connect one of the BNC cables to the external clock B input on the PI-5800 and the other end to one of the cascade clock outputs. Place the EXT CLK B switch in the ON position.

4. Connect the other BNC cable between one of the cascade clock outputs on thte PI-5800 and the CLK input on the PI-5810.

5. Connect the power cords to the PI-5810 and the PI-5800 to the power source.

6. Turn on the power to the PI-5810.

7. Turn on the power to the PI-5800. When both power switches are on, the PI-5810 is controlled by the PI-5800.

8. The PI-5800 now has total control over the PI-5810 Auxiliary Mainframe.

10.3 DATA OUTPUT CHANNELS

The data output channels continue the sequence as outlined in Section 4.6. With one PI-5810 added to the system, the output channel connections would be as follows: (Refer to rear panel connections for J1 - J4 equivalent pin drawings.)

J1 - Channels A33 through B40
J2 - Channels A41 through B48
J3 - Channels A49 through B56
J4 - Channels A57 through B64

11.0 PROGRAMMING THE PI-5800

11.1 GENERAL

The PI-5800 is programmed for use on the IEEE-488 bus through the use of simple statements. These statements are listed in Section 11.3.

Below you will find a sample program showing the steps required to output a pattern that is very similar to the pattern set-up that is described in Section 9.0, Quick Set-Up and Use.

The program listed does not include your controller commands on the string set-up, but lists the actual commands and the output sequence required.

***** NOTE: IT IS VERY IMPORTANT THAT ALL COMMANDS DE- *****
***** SCRIBED IN THIS SECTION BE SENT TO THE PI-5800 IN *****
***** ALL CAPITAL LETTERS. FAILURE TO DO SO WILL RE- *****
***** SULT IN SYNTAX ERRORS. ALSO, TERMINATE ALL COM- *****
***** MAND LINES WITH A <CARRIAGE RETURN>, <LINE FEED>, *****
***** AND AN EOI. TRANSMISSIONS FROM THE PI-5800 TO *****
***** THE CONTROLLER WILL BE TERMINATED SIMILARLY. *****
***** WHEN INPUTTING DATA FROM THE PI-5800, EOF, [IE. *****
***** END OF FILE (1A HEX), <CARRIAGE RETURN>, <LINE *****
***** FEED>, AND AN EOI. SEE IEEE-488 STANDARD FOR YOUR *****
***** CONTROLLER.] WILL BE SENT, WHEN THE UNIT *****
***** HAS COMPLETED SENDING THE REQUESTED DATA. *****
***** SPACES ARE IGNORED. IT SHOULD ALSO BE NOTED THAT *****
***** THE PI-5800 WILL NOT RESPOND TO ANY PROGRAMMING *****
***** COMMANDS IF THERE IS AN ERROR PENDING. IF THE SRQ *****
***** IS ENABLED, THEN A SERIAL POLL WILL CLEAR OUT ANY *****
***** ERROR STATUS. IF THE SRQ IS DISABLED, THEN A STATUS *****
***** COMMAND WILL CLEAR OUT THE ERROR. *****

COMMAND LINES	FUNCTION
CLEAR	Clears memory and resets Data Generator
DEFINE SP 1 (1-16)	Sets up subpattern 1 starting at bit position 1 and being 16 bits long
1 BEGIN 1	Includes program line and establishes Ref.# for program
COMPILE 1	Sets finish of program, and tells Data Generator that program is entered and ready to run. See Section 8.4.2.

LOAD CHANNEL A1	Selects channel that will be loaded with data
(10110011) * 1	Channel A1 data entry. See Section 11.2.1
UPDATE	Sends data into pattern memory
RUN	Runs pattern continuously

11.2 DATA ENTRY

There are two methods that can be used to program data into the PI-5800. These methods are Binary Entry, where the data is entered in 1's and 0's, and Hexadecimal Entry, where the data is entered in hex.

11.2.1 Binary Data Entry

In Binary Data Entry, the data is entered at the position of the cursor by enclosing the data to be entered in parenthesis and adding a multiplier. For example, the pattern 11011110 would be entered at the cursor position by sending the following command to the PI-5800: (11011110) * 1. The pattern could have been entered 100 times with the following statement: (11011110) * 100. For more information on this method of data entry see the sample program listed in Section 11.5.

11.2.2 Hex Data Entry

-- : -- SIZE -- ADDRESS -- 00 -- DATA BLOCK -- CHECKSUM --

Data Entry is accomplished by the insertion of the string diagrammed above. The individual blocks will be defined, and a sample data string will be assembled to demonstrate how the blocks are put together. The entry sequence is as follows:

: (colon) - START code required by the Intel ASCII Hex.

SIZE - Occupies two places in the string, written in hex. This number represents the number of bytes in the DATA BLOCK. A maximum of 32 (20 hex) bytes should be transmitted in each Intel ASCII Hex string.

ADDRESS - Occupies four places in the string, written in hex. This number represents the number of BYTES offset from the start of the channel where the BYTES of data in the DATA BLOCK are to begin being placed.

00 - Sync byte - Always 00 hex.

DATA BLOCK - Can be any length up to 32 bytes (256 bits), written in hex. Each BYTE of data in the DATA BLOCK represents 8 bits of data to the PI-5800 or the Pattern Entry and Editing Menu.

CHECKSUM - Occupies two places in the string, written in hex. This number is the least significant byte of the two's complement of the sum of every other byte in the Intel ASCII Hex string (DO NOT INCLUDE THE COLON <:>.).

11.2.2.1 Explanations of the Various Blocks of Intel ASCII Hex

SIZE - Size is the number of bytes in the data block entered into the string in hex notation. For example, the pattern 1110 1110 1111 1111 represents two bytes of data, so the hex number 02 hex would be written into the string in the size block.

ADDRESS - The address is the location in the channel where the first byte of the data block is to be placed. The addresses are divided into bytes from bit 1 to bit 4,096. For example, placing two bytes of data at bit position 1 in the channel would require the address 0000 hex (the first byte is 0 hex, and three additional 0's are added to fulfill our requirement of four places. So the addresses can range from 0 to 512 decimal (0 hex to 200 hex). 512 is achieved by taking the maximum number of bits (4,096) and dividing by 8 to convert to bytes. The address must then be converted to hex for entry.

Bit Positions	1 - 8	9 - 16	17 - 24	...	4,088 - 4,096
Address	0	1	2	...	512
Hex Entry	0000	0001	0002	...	0200

Since the PI-5800 requires data to be entered in whole byte format, there are situations where you must adjust your data entry to provide the whole byte required. For example, if you are entering your data at bit location 27, which is in address location 0003 hex, you are attempting to enter an incomplete byte into the location. There are two methods to remedy the situation.

1. You can fill the locations with zeros.

Bit Positions	25	26	27	28	29	30	31	32
Pattern Data	0	0	1	1	1	1	1	1

This method is used when you do not have another pattern occupying bit positions 25 and 26.

2. If you do have another pattern built at bit positions 25 and 26, you must include these bits also in your pattern to make the byte entry complete.

Bit Positions	25	26	27	28	29	30	31	32
Pattern Data	1	1	1	1	1	1	1	1

All entries to address locations must include the entire address either by adding zeros to the pattern to complete the location or by adding part of an existing pattern into the spaces to fill up the address location.

00 - 00 is a sync byte and is always entered into the string as 00.

DATA BLOCK - The data block is the actual data pattern in hex that you want to output. It can be from 1 to 32 bytes and is entered in hex.

CHECKSUM - The check sum is the least significant byte of the two's complement of the sum of all the bytes in all the other blocks except the colon, ie. SIZE, ADDRESS, DATA BLOCK. The two's complement is also expressed in hex. The two's complement is formed arithmetically by complementing the number and adding 1. For example, the two's complement of 0011 0111 would be its complement plus 1, or 1100 1000 + 0001 or 1100 1001. This would be entered into the string as C9 hex. Remember - the checksum is the least significant byte of the two's complement of the SUM of all the other blocks in the Intel ASCII Hex string.

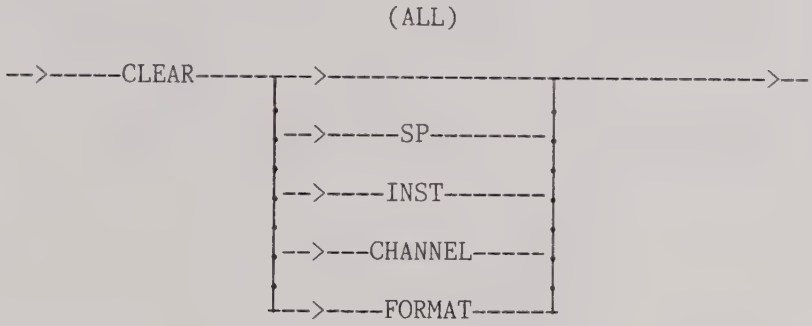
11.2.2.2 Putting the Blocks Together

Once the individual blocks have been established, the entire pattern is put together as follows:

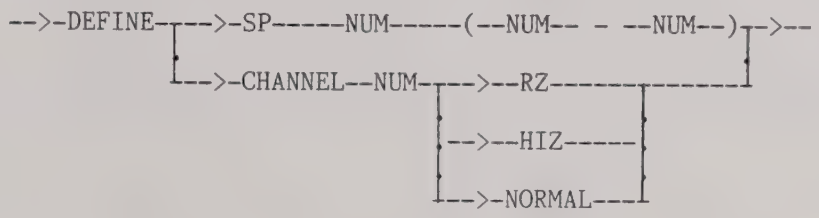
```
        :02       0000       00        EEFF          11

   -- SIZE -- ADDRESS -- 00 -- DATA BLOCK -- CHECK SUM --
```

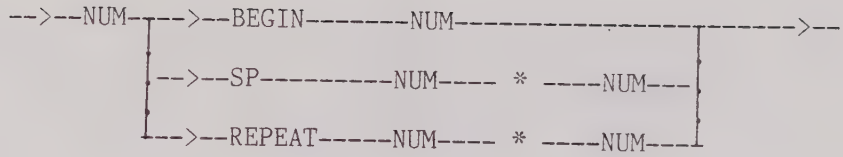
11.3 PROGRAMMING COMMANDS



The CLEAR is the system master reset. It clears out all volatile memory and resets the system when the CLEAR is the only command. When used in conjunction with the lower paths it will clear each item as required. (NOTE: SP = Subpatterns, INST = Instructions.)



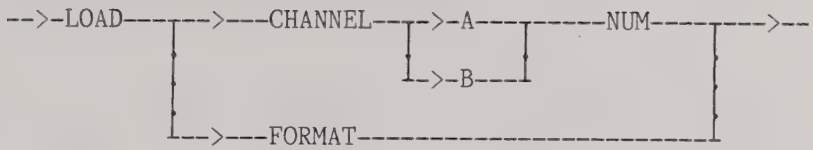
DEFINE sets up the subpattern number and bit loctions. Example: DEFINE SP 3 (17 - 33) sets subpattern 3 to start at bit 17 and be 33 bits long. DEFINE is also used to set up the mixed-mode operations, ie. RZ/NRZ and HI-Z. (Note: RZ = RZ/NRZ in this context.)



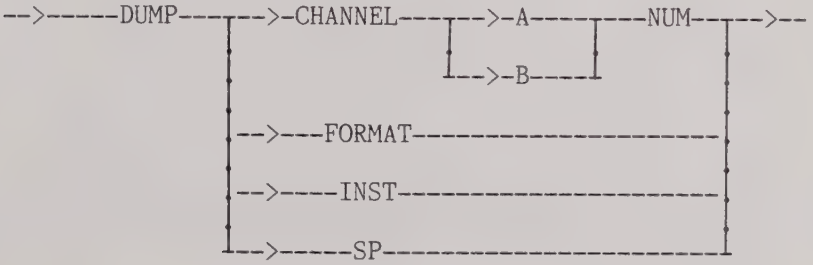
The statements above are used in establishing the actual program as it appears on the Instruction Entry and Editing Menu. The beginning NUM is used for setting the line number. The Begin statement is used for identifying a particular program, and the next two paths are used for setting the subpattern and repeat statements into the program. The first NUM in the SP path defines the subpattern number to used. The second NUM in the SP path is the repetition factor for that particular subpattern. The first NUM in the REPEAT path is the "FROM" number (See Section 8.4). The second NUM in the REPEAT path is the repetition factor for that particular instruction. Here is an example of their use:

```
1 BEGIN 1
2 SP 1 * 5
3 SP 2 * 3
4 REPEAT 2 * 3
5 SP 1 * 1
6 SP 3 * 3
7 REPEAT 6 * 1
```

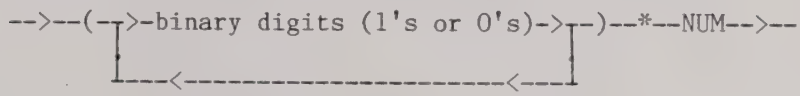
COMPILE translates the series of commands referenced by the begin number (NUM) into instructions that the PI-5800 can understand.



LOAD prepares the selected channel, for receiving data patterns, or loads the block format. LOAD puts the PI-5800 into a state where it is waiting for data to be passed to it in the form of Intel ASCII Hex. (See Section 11.2). In order to better understand the form of the data expected in the use of this command, it is recommended that the user try the DUMP command. The PI-5800 dumps out data in the same Intel ASCII Hex format that it accepts it.

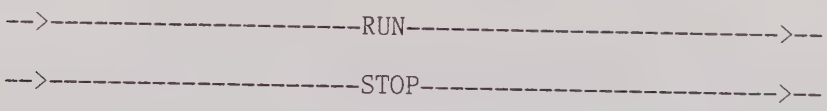


The DUMP command will prepare the PI-5800 to dump out the data associated with the form of the command used. If the command DUMP CHANNEL A 1 is sent, the PI-5800 will be prepared to send out the data stored in channel A1 upon request. The data will be in the form of 16 Intel ASCII Hex strings. The end of the transmission will be identified by an EOI (See IEEE-488 Standard.)

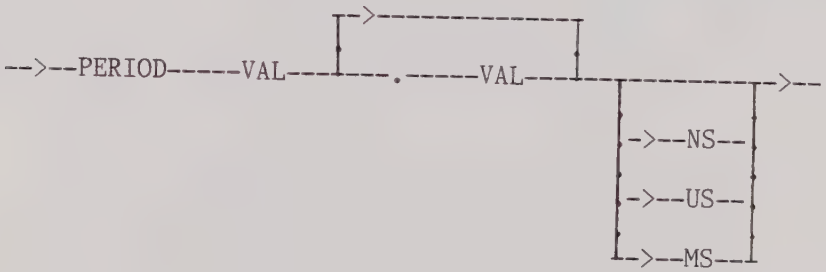


This command enters binary data starting at the present location of the cursor. Use the GOTO command to position the cursor. See Sections 11.2.1 and 11.5.

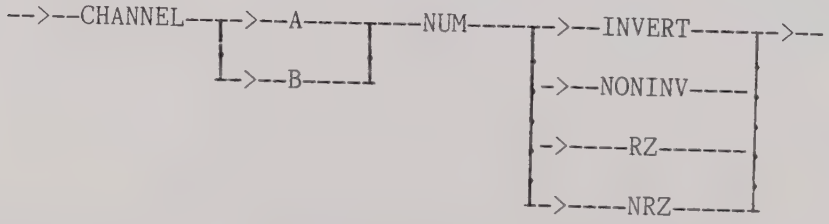
Places the data pattern into pattern memory to be run.



RUN starts the pattern output. The RUN command places the unit in an automatic mode and it will continue to output and repeat the compiled program until the STOP command is sent.

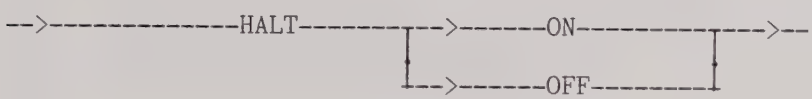


The internal period is set using the above formula. The term VAL represents a group of digits which hold the whole and fractional parts of the value of the period to be set. NS, US, and MS are nanoseconds, microseconds, and milliseconds, respectively. (See Section 8.6.3 for details regarding the range of values that can be set. See Section 11.5 line 560 for an example.)

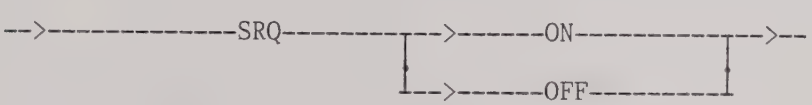


This command sequence is used for setting any selected channel's output format. See Section 8.5.3. (NOTE: NONINV = Non-Invert.)

Used to place the PI-5800 in or out of Cascade Mode. See Section 8.3.9.



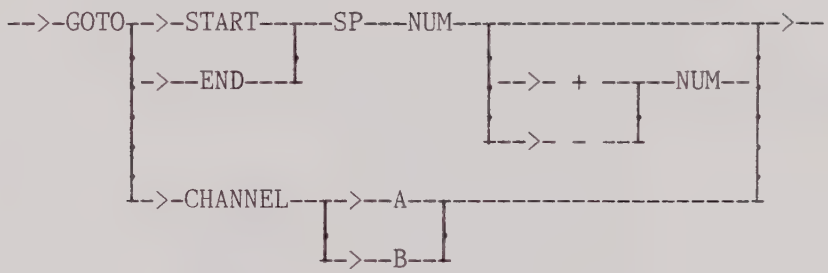
HALT turns on or off the external halt function. (See Section 8.6.2.)



Turns the Service Request ON or OFF. Note that the PI-5800 will respond to a Serial Poll by transmitting the error code which generated the Service Request. (See IEEE-488 Standard and Section 12.0.)

Provides status of error messages or information on the Run/Stop condition. Send this command to the PI-5800 then "INPUT" the data into your controller. This command clears out any error that might be pending. NOTE: THE PI-5800 CEASES TO RESPOND TO PROGRAMMING COMMANDS WHEN THERE IS AN ERROR PENDING.

11.4 Editing Commands



The GOTO statement allows quick access to various channel, bit, and subpattern locations. See Section 8.3.6. This command moves the cursor to the desired location in the Pattern Entry and Editing Menu.

The DELETE SP command will delete any selected subpattern by removing it from the Pattern Entry and Editing Menu.

11.5 SAMPLE PROGRAM FOR PI-5800 (written in BASIC)

```
10   REM    ************************************************
20   REM    *                                              *
30   REM    *  This is a sample program which will         *
40   REM    *  demonstrate how to program the PI-5800 DATA  *
50   REM    *  GENERATOR.                                  *
60   REM    *                                              *
70   REM    ************************************************
80   REM
90   REM    In line 110, the IEEE address is 7.
100  REM
110  OPEN 1,7
120  REM
130  REM    The following three lines define 3 subpatterns:  the
140  REM    first starting at bit position 1 and being 20 bits
150  REM    long, the second starting at bit position 20 and
160  REM    being 51 bits long, etc.
170  REM
180  PRINT #1,"DEFINE SP1(1-20)"
190  PRINT #1,"DEFINE SP2(20-51)"
200  PRINT #1,"DEFINE SP3(100-1000)"
210  REM
220  REM    The following four lines define a program to output
230  REM    the subpatterns in the following order:  (SP1 X 1) +
240  REM    ((SP2 X 3) + (SP3 X 1)) X 5.
250  REM
260  PRINT #1,"1 BEGIN 1"
270  PRINT #1,"2 SP1 * 1"
280  PRINT #1,"3 SP2 * 3"
290  PRINT #1,"4 SP3 * 1"
300  PRINT #1,"5 REPEAT 3 * 5"
310  REM
320  REM    The next line will compile the above set of
330  REM    instructions into a language that the machine can
340  REM    understand.
350  REM
360  PRINT #1,"COMPILE 1"
370  REM
```

```
380  REM    The next few lines will load some data into channels
390  REM    A1 and B16.  This is meant only as an example.
400  REM
410  PRINT #1,"GOTO CHANNEL A1"
420  PRINT #1,"GOTO 1"
430  PRINT #1,"(00000000111010101010101010101010100000) * 1"
440  PRINT #1,"GOTO CHANNEL B16"
450  PRINT #1,"GOTO 10"
460  PRINT #1,"(011) * 20"
470  REM
480  REM    The next line will update the pattern memory with the
490  REM    data just entered.
500  REM
510  PRINT #1,"UPDATE"
520  REM
530  REM    The next line will set the internal period to
540  REM    302.1 microseconds.
550  REM
560  PRINT #1,"PERIOD 302.1 US"
570  REM
580  REM    The next line starts the DATA GENERATOR.
590  REM
600  PRINT #1,"RUN"
610  REM
620  CLOSE 1
630  END
```

12.0 ERROR AND WARNING MESSAGES

12.1 GENERAL

Below is a list of the PI-5800's error messages and warnings. When an error occurs or a warning is necessary, the message will be displayed on the menu you are presently using. The error message is removed by pressing any key; the warning message is removed by pressing any key except [ENT].

In the program mode, the errors and warnings are transmitted to the controller in the form of the NUMBERS associated with the error messages specified in Section 12.2, below.

12.2 EXPLANATION OF ERROR AND WARNING MESSAGES

1. B CHANNEL WILL NOT TRI-STATE - An attempt was made to place a B channel in High Impedance mode. Since the B Channel is used for control, it cannot be used in High Impedance mode. Place the cursor in the appropriate A Channel. See Sections 8.3.6 and 8.5.4.

2. DATA IN B CHANNEL WILL BE LOST - When setting an A Channel into Mixed Format mode, the paired B Channel acts as a control channel. Once the warning is issued, if you press [ENT], the B Channel will go into control mode and immediately "overwrite" any data in B Channel memory. See Section 8.5.4 for a discussion of mixed formats, and Section 8.3.6 for discussion of [RZ (ON/OFF)] and [HI-Z] softkeys.

3. INVALID FORMAT - An attempt was made to change output format from Hi-Z or RZ/NRZ, to RZ/NRZ or Hi-Z. Any change from Hi-Z or RZ/NRZ formats must be made through Normal mode (See Section 11.3.). Go from Hi-Z or RZ/NRZ mode to Normal, then make the required change. See Sections 8.3.6, 8.5.4, and 11.3.

4. B CHANNEL WILL NOT RETURN TO ZERO - An attempt was made to set the B Channel in Mixed Format mode. Since the B Channel is used for control, it cannot be used in Mixed Format mode. Place the cursor in the appropriate A Channel. See Section 8.5.4.

5. NUMBER TOO LARGE - An attempt was made to enter a number out of range. Normally occurs when trying to go to a subpattern above 255, or trying to enter a programming line greater than 999.

6. SYNTAX ERROR-INPUT IGNORED - Normally occurs when the wrong instruction sequence was entered or upon receipt of a command word which is mis-spelled.

7. SUBPATTERN START NOT DEFINED - An attempt was made to enter a subpattern end without a subpattern start being defined. Establish the start of the subpattern by placing the cursor at the required bit position and pressing the START SP softkey. See Section 8.3.3. Also, if an attempt is made to GOTO a subpattern start that is not defined, this error will result.

8. OFFSET ERROR - An out-of-bounds condition normally displayed when using GOTO SUBPATTERN START or END routines. An attempt was made to go to a bit position that was above or below the 4,096 bit channel memory.

9. CHANNEL MEMORY FULL - All 4,096 bits in the channel have been committed. There is no more memory available in the channel.

10. OVERFLOW - An attempt was made to enter a number larger than 65,535.

11. NUMBER TOO SMALL - An attempt was made to enter a number less than 0.

12. MINIMUM SUBPATTERN LENGTH IS 12 - An attempt was made to enter a subpattern with less than 12 bits which is the minimum subpattern size allowable. If you require a pattern of less than 12 bits, build it into another pattern. For example, if you require a subpattern of 16 bits to run 10 times followed by a subpattern of 3 bits that will run one time, you can build the 16-bit subpattern to run nine times, then build the same 16-bit pattern and add the 3 bits. Now run your new 19-bit pattern one time and you have accomplished your task. See Section 8.3.2 and 8.3.3.

13. SUBPATTERN END NOT DEFINED - An attempt was made to enter a subpattern with a start position established, but no end to the pattern. Establish the end of the subpattern by placing the cursor at the required bit position and pressing the [END SP] softkey. See Section 8.3.6. Also, if an attempt is made to GOTO a subpattern end that is not defined, this error will result.

14. COMPILE ERROR - An attempt was made to compile a program which is not able to be compiled. See Section 8.4.3.

15. CAN'T GOTO THAT CHANNEL - An attempt was made to GOTO a B Channel that is presently being used as a control channel for its paired A Channel. Go to the appropriate A Channel.

16. NO LISTENERS - The IEEE-488 controller has given the PI-5800 the command to "Talk" and there is no instrument on the bus in the "Listen" mode. See Section 11.0.

17. CHECKSUM ERROR - The checksum that has been computed by the PI-5800 on the last Intel ASCII Hex transmission that it had received, has not matched up with the checksum that came across with that data transmission. See Programming Section 11.2.

The following errors (18 through 22) are compile errors associated with the programs generated in the Instruction Entry and Editing Menu (See Section 8.4 for details.):

18. INVALID BEGIN NO. - The program that has been asked to be compiled does not exist. Only compile defined Begin Numbers.

19. NO DEFINED SUBPATTERNS - A compile has been attempted, but no subpatterns had been previously defined. Define the subpatterns that are used in the particular program to be compiled.

20. INVALID FROM NO. - Within a REPEAT instruction in the program to be compiled, the "FROM" number (See Section 8.4.2) is impossible to accomplish within the limits of two-level looping.

21. SHOULD BE SUBPATTERN INSTRUCTION - An inappropriate instruction has been entered within a program.

22. INVALID SUBPATTERN NO. - A compile has been attempted of a program which attempts to use a subpattern which is not yet defined.

23. UPDATE ERROR - Occurs whenever there is an error in data transfer between CPU Ram and Pattern Ram. This error could occur during Update or Dynamic Update.

24. PERIOD TOO LONG - An attempt was made to enter an Internal Clock Period that exceeded 1.3107 milliseconds. Internal Clock Periods must be entered within the range of 20 nanoseconds to 1.3107 milliseconds in 20 nanosecond increments. See Section 8.6.3.